Fighting Global Hunger: Developing Agroforestry Education Techniques

Dustin M. Homan and Dr. Robert J. Birkenholz

The Ohio State University and World Agroforestry Centre (ICRAF)

Abstract

World food production must increase by 70%, and double in developing countries, in order to adequately feed an additional two billion people projected to inhabit Earth by the year 2050. Dissemination of new agricultural technologies to farmers, specifically young farmers who must be part of the solution in 2050, should be pursued. The World Agroforestry Centre (ICRAF) has identified specific fertilizer trees that, when incorporated into farming systems, have been proven to nearly double crop yields in Sub-Saharan Africa. Unfortunately, ICRAF lacks strategies to disseminate and implement this technological innovation throughout Africa.

The objective of this study was to recommend teaching techniques for disseminating knowledge about agroforestry to Kenyan youth for ICRAF to use in future curriculum development. Ten schools in Kenya were selected by ICRAF and visited to present a brief program about agroforestry to students. Each presentation consisted of an introduction, learning activities to teach basic agroforestry concepts, and an evaluation. Overall, twelve techniques were used to teach the Kenyan students about agroforestry concepts. Each technique was observed and rated by three presenters based on factors including: the students' ability to recall knowledge and their interest/excitement in participating in each activity. Personal interviews were also conducted with teachers, students and community members to assess other contextual factors that may have been related to the effectiveness and/or impact of the educational program.

Based on observations and ratings, lessons that incorporated stories and experiential learning activities appeared to be most effective in disseminating information to students. Based on the results of this study, ICRAF can now proceed to develop more effective lessons to increase agroforestry awareness and practices among young farmers.

Background

According to the Food and Agriculture Organization (FAO) of the United Nations (2009), the world population is expected to grow by over a third, to approximately 9.1 billion people, by 2050, and the fastest population growth is expected to occur in sub-Saharan Africa. Coinciding with this population increase is depleting natural resources and a global food shortage crisis. Feeding an additional two billion people projected to inhabit the Earth by 2050 would require raising food production by some 70% globally and, specifically, doubling it in developing countries (FAO, 2009). Two solutions should be actively pursued to veer off this looming threat - new research in and application of production agriculture technologies and dissemination of this information to producers, specifically youth who will be the solution to the food crisis in 2050.

Researchers from the International Centre for Research in Agroforestry (ICRAF), also known as the World Agroforestry Centre, in Nairobi, Kenya are investigating agricultural practices that can be easily incorporated into rural farms to help increase food output. ICRAF is part of The Alliance of the Consultative Group on International Agricultural Research (CGIAR) Centres - a global network of 15 research centers. The vision of the World Agroforestry Centre is to advance the science and practice of agroforestry, or the use of working trees on farms, to help realize an agroforestry transformation throughout the developing world (World Agroforestry Centre, 2012). In 2010, a plot study incorporated the tree species *Faidherbia albida* into production agriculture practices. In the control plot without the trees, total crop production was measured at 2.6 tons per hectare while the plot with the trees nearly doubled that output to 5.6 ton per hectare (Garrity, 2011). Defined as agroforestry, this technique focuses on utilizing trees on farms and in rural landscapes to provide fertilizer to crops from falling leaves to boost

production output levels. Incorporating trees also benefits farmers by increasing their soil health and food security, providing fodder that improves smallholder livestock production and producing timber for shelter and energy (World Agroforestry Centre, 2011).

According to the United States Department of Agriculture (USDA) (2010), in 1945, American farmers could produce 100 bushels of corn on two acres of land. Today, American farmers produce the same 100 bushels of corn on less than one acre (USDA, 2010). This rapid improvement can be connected to the extensive network of land grant institutions, agricultural research centers, and county and regional offices that all collectively work under the umbrella of extension. "Along with teaching and researching, land-grant institutions 'extend' their resources, solving public needs with college or university resources through non-formal, non-credit programs" (USDA, 2010).

An approach to the two solutions outlined earlier includes combining the best management practices of agroforestry with a successful extension and outreach model incorporating effective teaching strategies. However, while the knowledge and application of agroforestry is available, there exists no outlet or materials to effectively distribute the knowledge to the African population. Additionally, based on observations and interviews conducted with teachers and students at 10 rural primary schools, many Kenyan teaching strategies appeal only to verbal and logical student intelligences, which are student-learning styles based off of Dr. Howard Gardner's Theory of Multiple Intelligences (Phipps et al., 2007). According to the theory, students possess different kinds of minds and, therefore, learn, remember, perform and understand in different ways (Kagan & Kagan, 1998). Dr. Gardner identified a total of eight student-learning styles, which means that six of the eight learning styles are typically not stimulated in many Kenyan classrooms. The teachers' focus on techniques

appealing to verbal and logical intelligences may stem partially from influences of the British education system since Kenya was formally a British colony.

Objective

The objective of this study was to qualitatively analyze teaching techniques for disseminating knowledge about agroforestry to Kenyan youth to assist with future lesson plan development.

Methodology

Three student facilitators visited 10 rural, primary schools in Kenya to deliver a lesson they prepared about agroforestry. Each lesson consisted of three parts:

1. **Introduction and Interest Approach**

The presenters introduced themselves, attempted to breakdown cultural barriers through a cheer and discovered previous knowledge about agroforestry. Initially, paper pre- and post-assessments were designed to measure any change in the students' knowledge about agroforestry before and after the lesson, respectively. Unfortunately, due to time constraints and the students' unfamiliarity with this type of assessment, the paper assessment had to be discarded and replaced with a modified, verbal assessment. At nine of the ten schools, the facilitator asked students to stand up if they had ever planted a tree. From those standing, the facilitator then asked students to name a tree species and identify benefits of planting trees.

Figure 1 Cheer during the interest approach

2. Teaching Agroforestry Concepts

For the most part, the content delivered during all of the lessons stayed the same. The content had to be modified after the first few initial visits due to the facilitators' unfamiliarity with the schools' physical facilities, some language barriers between the students and facilitators, and the length of the lesson, which was initially too long. The content included the steps of the agroforestry cycle and the four main types of agroforestry trees (i.e. fertilizer, fruit, fodder and firewood). Various teaching techniques were used to present the content in order to meet the objective of this study. Those techniques included:

Figure 2 Living story technique

a. Living story
b. Scavenger hunt
c. Write and sing a song
d. Draw a template for a talking wall
e. Compose individual and group narratives
f. Conduct a skit
g. Develop a plan for a community fair
h. Draw a mentor text
i. Group pair-and-share
j. Cooperative learning
k. Charades
l. Write a script for and film a commercial

3. Evaluation and Application

Students were asked to recall knowledge from part two of the lesson by writing the four main types of agroforestry trees and benefits of trees, as outlined in the agroforestry cycle, on the front and back of six foam puzzle pieces after being prompted by one of the facilitators. The students then put the puzzle pieces together to form a cube that was left with the student for them to help spread awareness of agroforestry. The class also brainstormed a list of ways to share the knowledge they had learned with their community. After the lesson, interviews were also conducted with students, teachers and community members to better understand and assess contextual factors.

Figure 3 Evaluation activity

Results

Over 700 primary students were reached through ten unique presentations.

The facilitators were asked to make recommendations about the teaching techniques listed above. Specifically, the facilitators were asked to reflect upon each teaching technique based on their interpretation of how effectively the students' comprehended instructions for each teaching technique, and their abilities and enthusiasm to perform the techniques. Also factored into the recommendations below were the students' ability to recall knowledge in the evaluation part compared to their answers to the facilitators' questions in the introduction, as well as their answers to follow-up interview questions. Finally, the facilitators connected each activity to the respective student intelligences that they believed were stimulated through the technique.

The facilitators recommended not using the charades and commercial teaching techniques in future lessons due to poor comprehension and engagement, and cultural barriers. For instance, most students had not seen a television commercial before, so its concept was unfamiliar to them. The students reveled at the flip-camera they were provided, but did not understand its use.

The facilitators recommended using all of the other teaching techniques in future lessons. The facilitators identified the living story as the most effective technique based on the factors listed above. Additionally, this technique also incorporated the most intelligences compared to the other techniques. An explanation of the technique, and intelligences exhibited through the story, follows.

The living story consisted of a student narrator reading a provided story about the agroforestry cycle out loud, a stimulus for verbal intelligences. After each paragraph, the narrator would stop and five student volunteers, representing a farmer, tree, animal, crop and soil, would act out the story previously read by the narrator, which appealed to visual and bodily intelligences. The story's incorporation of a farmer allowed the students to visualize themselves in that role and enjoying the benefits from the tree because nearly all of the students lived on farms, which attracted to intrapersonal intelligences. The cause-effect relationships of benefits derived from planting trees, including a larger crop yield and healthier animals, appealed to logical intelligences. Finally, the story's setting and characters were all from the natural world, a stimulus for naturalist intelligences.

Figure 4 Intelligences exhibited through the living story

Other contextual factors discovered during the interviews, which may assist future lesson development, included:

- Students enjoy learning and conducting activities in small groups;
- Students enjoy reading stories about people, animals and the environment; and
- Students enjoy learning both inside and outside of the physical classroom.

Future Research

It is recommended that a follow-up study be conducted with the same ten schools to gauge their level of responsiveness to the lesson by observing the scale of agroforestry practices in the school and surrounding community compared to the practices witnessed when the three facilitators initially visited. Future lessons should build upon this study by focusing on the lack of adequate technical advice and educational materials, especially concerning the appropriate tree species to plant, witnessed in the schools. Also, more culturally appropriate pre- and post-assessments need to be developed for future lesson plans to distinguish the students' increase in awareness from the lesson versus previous knowledge they might have had.

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